Ecological Economics 111 (2015) 12–22

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

What influences the probability of wind farm planning approval: Evidence from Ireland

Thomas M. van Rensburg [a], Hugh Kelley [a,*], Nadine Jeserich [a,b]

[a] Department of Economics, Cairnes School of Business and Economics, National University of Ireland, Galway, Galway, Ireland
[b] GrowthEconomics, Inc. 2425 Gulf of Mexico Dr., Longboat Key, FL 34228, USA

ARTICLE INFO

Article history:
Received 11 February 2014
Received in revised form 27 October 2014
Accepted 27 December 2014
Available online 22 January 2015

Keywords:
Wind-energy
Planning-approval
Revealed-preference

ABSTRACT

The purpose of this work is to explore the extent to which wind farm planning approvals in the Republic of Ireland are influenced by project technology, institutional processes, and site endowments. We use principal components data reduction, z-score data normalization, and Probit regression analyses on a unique revealed preference dataset covering 354 wind farm applications and planning authority decisions between 1990 and 2011. Notably, a unique measure of variable importance is employed that mitigates statistical problems and allows for the ranking of predictors according to their relative influences. Findings reveal that the duration of the local appeal process, decisions of local authorities and inspectors, identities of the appellants, and, projects that conflict with strategic development plans or generate visual externalities emerge as key influences affecting planning approval. Project technology features such as area, rated output capacity, and hub height, as well as site wind endowments, appear to be of less but significant importance. Alternatively, we find that proximity to dwellings, towns, or protected habitats does not influence planning outcomes.

1. Introduction

An important question within the wind energy literature concerns the factors that are empirically associated with wind farm (WF) planning approvals. Having reliable predictors of project planning approval can assist planners and investors to develop better applications, and can help all parties better assess the risks and returns of WF projects. Unfortunately, only a few studies have attempted to rigorously quantify key influences on historical planning outcomes (Haggett and Toke, 2006; Horst, van der and Toke, 2010; Toke, 2005a, 2005b). Most other studies rely upon findings from stated preference surveys and choice experiments investigating public attitudes and perceptions about wind power (Alvarez-Farizo and Hanley, 2002; Bergmann et al., 2006; Longo et al., 2008; Yadav et al., 2012). Such studies find conflicting positive (Eltham et al., 2008) and negative attitudes (Devine-Wright, 2005a; Landenburg and Dubgaard, 2007; Meyerhoff et al., 2010; Navrud and Braten, 2007), where the latter responses are more common the greater the degree of proximity of the project to the respondents' residences, i.e. NIMBYism. Although such stated preference studies are informative, for the most part they are hypothetical ex ante studies focusing on public preferences rather than outcomes and therefore they do not yield many practical insights for those involved in the planning approval process. This limitation could lead to circumstances where the decisions of planning authorities appear random or influenced by unobserved factors, potentially leading applicants to perceive political as well as financial risk when evaluating projects. This may cause risk averse developers to refrain from initiating projects, and this in turn could compromise a nation's ability to enhance the share of renewables in their energy generation portfolios and to comply with government directives. See the European Directive on Electricity Production from Renewable Energy Sources (Míguez et al., 2006), and the U.S. Renewable Electricity Standard (Delmas and Montes-Sancho, 2011).

Despite the limitations of some of these studies, one of their contributions has been the listing and categorization of potential influences on the likelihood of WF success. Based on this work we propose that key predictors of planning approval success generally relate to *project* technology, institutional *processes*, and site *endowment* characteristics; several *control* variables are also included. By analyzing all these variables in an integrated framework, and by normalizing our non-binary data, we can identify significant influences, we can compare the relative magnitudes of these associations, and we can address key questions in the literature. Our method follows from Kelley (1998), Jeserich et al. (2012), Laepple and Kelley (2013), and Kelley et al. (under review), and allows us to mitigate a variety of statistical problems that plague this data. Several robustness checks confirm that our approach addresses these issues and provides robust parameter estimates.

There are multiple objectives of this study. A methodological objective is to correct for a variety of statistical problems within our revealed preference dataset, including variations in predictor distributional

* Corresponding author.
E-mail addresses: thomas.vanrensburg@nuigalway.ie (T.M. van Rensburg), hugh.kelley@nuigalway.ie (H. Kelley), nadine@growtheconomics.com (N. Jeserich).

http://dx.doi.org/10.1016/j.ecolecon.2014.12.012
0921-8009/

properties and magnitudes, the presence of outliers, and predictor collinearity. We do this by sequentially employing z-score data normalization, principal components analysis (PCA) data reduction, and then Probit analyses. Our quantitative objective is to address two research questions. First, what are the relative magnitudes of the associations among wind farm project planning approvals and control, institutional process, wind farm project, and location endowment attributes? Second, how can *controllable* (by an involved party) attributes be used to influence the probability of approval?

2. Data and Variables

The datasets for this study were laboriously assembled from public data sources including Irish county level planning authorities, the national appeals board An Bord Pleanala, the Sustainable Energy Authority of Ireland wind speed database, and from company records for applicants. This revealed preference data describes actual planning outcomes and project characteristics, and are grouped into five categories. The first includes the multiple variables reflecting different levels of the application process that are used to construct our planning approval dependent variable. This variable captures planning approval success along any of the multiple paths (e.g. immediate local approval with no objections, approval only after all appeal attempts, and all variations in between these extremes). The remaining four categories describe control, endowment, process, and project predictor variables. For the purpose of avoiding the dummy variable trap, predictor variables are further disaggregated into topical sub-categories and one variable from each sub-category is dropped so as to facilitate intuitive interpretation of remaining parameters. The sub-categories include institutional process, ecological effects, human welfare effects, and project technology sub-categories.

2.1. Study Area

The physical setting within which we investigate WF planning approval is the Republic of Ireland between 1990 and 2011. Our data set covers 354 projects, out of an estimated total of 1300, for 23 of the 26 counties in the Republic of Ireland. These include all counties except, for obvious reasons, the urban counties of Dublin, Kildare and Meath. Table 1 provides descriptive statistics for this data and Table A.1 in Appendix A provides detailed descriptions of our variables and provides an intuitive sense about what they describe. For the binary data in Table 1, i.e. variables with a minimum of 0 and a maximum of 1, a value of 1 indicates that the described variable name/outcome occurred, unless otherwise noted. For example, the 1st Inspector Granted Approval equal to one indicates this happened. The units for the continuous

Table 1
Descriptive statistics for wind farm data for Republic of Ireland between 1990 and 2011. Number of observations N = 354.

Variable	Variable type	Mean	S.D.	Min.	Max.
Project approval	Dep. var	0.20	0.38	0	1
Closest town (km)	Control	4.30	2.81	0	19.00
WindEndowment (ave mps)	Endowment	8.12	0.70	6.29	10.79
Appeal1Duration (days)	Process:Insitut.	66.96	139.17	0	734.12
Time2Ap1 (days)	Process:Insitut.	68.12	334.13	0	2000
TotLocDuration (days)	Process:Insitut.	175.04	244.39	0	2000
1st Inspect Grant (1 = yes)	Process:Insitut.	0.00	0.05	0	1
1st Inspect Refuse (1 = yes)	Process:Insitut.	0.19	0.38	0	1
Appeal–Applicant (1 = yes)	Process:Insitut.	0.22	0.41	0	1
Appeal–Group (1 = yes)	Process:Insitut.	0.01	0.12	0	1
Appeal–AffectParty (1 = yes)	Process:Insitut.	0.02	0.15	0	1
Appeal–ThirdParty (1 = yes)	Process:Insitut.	0.18	0.38	0	1
Bord Withdrawn (1 = yes)	Process:Insitut.	0.02	0.13	0	1
LA refused (1 = yes)	Process:Insitut.	0.28	0.44	0	1
REF archeology (1 = yes)	Process:Ecol. Effect	0.00	0.05	0	1
REF Birds (1 = yes)	Process:Ecol. Effect	0.02	0.14	0	1
REF Cum. Impacts (1 = yes)	Process:Ecol. Effect	0.01	0.11	0	1
REF EIA (1 = yes)	Process:Ecol. Effect	0.01	0.09	0	1
REF Flooded area (1 = yes)	Process:Ecol. Effect	0.00	0.05	0	1
REF Flora (1 = yes)	Process:Ecol. Effect	0.01	0.07	0	1
REF Habitat (1 = yes)	Process:Ecol. Effect	0.01	0.09	0	1
REF Peat Stability (1 = yes)	Process:Ecol. Effect	0.02	0.14	0	1
REF Prox Natura (1 = yes)	Process:Ecol. Effect	0.01	0.11	0	1
REF Aviation (1 = yes)	Process:Human Effect	0.01	0.07	0	1
REF StratDevPlan (1 = yes)	Process:Human Effect	0.12	0.31	0	1
REF Prox Dwelling (1 = yes)	Process:Human Effect	0.05	0.20	0	1
REF Public Safety (1 = yes)	Process:Human Effect	0.02	0.12	0	1
REF Tourism (1 = yes)	Process:Human Effect	0.01	0.09	0	1
REF Visual (1 = yes)	Process:Human Effect	0.17	0.36	0	1
Applicant–Individual (1 = yes)	Project:General	0.38	0.48	0	1
Applicant–Ltd (1 = yes)	Project:General	0.57	0.49	0	1
Applicant–Subsid. (1 = yes)	Project:General	0.08	0.26	0	1
Applicant–Country (1 = ROI)	Project:General	0.96	0.20	0	1
Contract Amend. (1 = yes)	Project:General	0.02	0.14	0	1
Contract Exten. (1 = yes)	Project:General	0.02	0.15	0	1
Perm Extension (1 = yes)	Project:General	0.02	0.14	0	1
Permission (1 = yes)	Project:General	0.93	0.25	0	1
Windfarm Exten (1 = yes)	Project:General	0.01	0.12	0	1
EIS (1 = yes)	Project:General	0.63	0.42	0	1
Area (ha)	Project:Technology	37.20	79.49	0	1092.00
Hub height (m)	Project:Technology	55.67	19.89	6	115.77
No. of turbines (#)	Project:Technology	6.16	6.84	1	48
Rated OutCap (MW)	Project:Technology	10.66	11.71	0	105.00
Rotor Diameter (m)	Project:Technology	55.89	23.50	1.70	114.00